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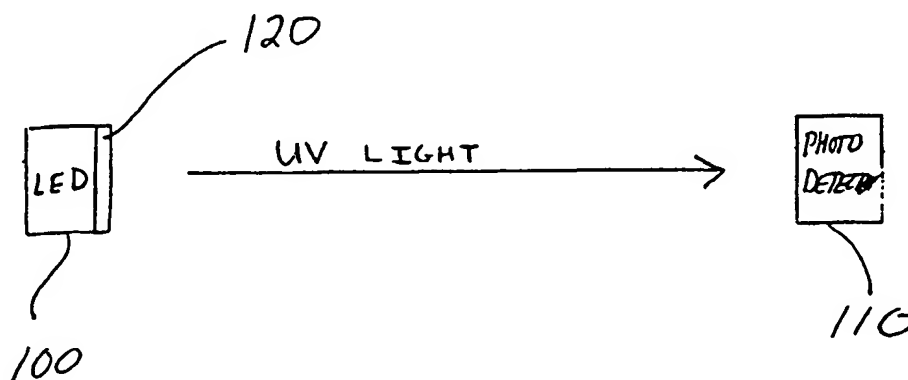
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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHODS AND APPARATUS FOR COMMUNICATION USING UV LIGHT



(57) Abstract: Communication methods and apparatus using ultraviolet (UV) light are provided. Safe UV communication devices, including remote control units, can use highly efficient UV LEDs and very low-noise UV photodetectors (110). In some cases, the LEDs (100) emit light at wavelengths below 400 nm, below 320 nm, or even below 280 nm. In one embodiment, communication can be achieved using an LED (100) that emits less than about 1 picowatt of UV energy at a photodetector distance of up to at least about 10 meters. Longer range communication can also be achieved at higher power levels. Photodetectors (110) having very low dark currents at room temperature, such as below about 1×10^{-9} A/m², or even below about 1×10^{-12} A/m², are preferable.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/22471

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : H04B 10/02, 10/04, 10/06, 10/08, 10/16; H01S 3/13; H04R 15/00, 17/00; G02F 1/33; F21V 09/06
US CL : 398/38, 106, 118, 126-128, 130, 133, 135, 138, 140, 173, 182, 202, 208; 372/29.012; 367/140; 359/311, 350, 361;

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 398/38, 106, 118, 126-128, 130, 133, 135, 138, 140, 173, 182, 202, 208; 372/29.012; 367/140; 359/311, 350, 361;

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y,P	US 2002/0149822 A1 (Stroud) 17 October 2002 (17.10.2002), [0067], [0027], [0030], [0036] and Fig. 8	1-13, 15-17, 20-21, 25-37
Y	US 5,093,576 A (Edmond et al) 03 March 1992 (03.03.1992), Col. 3, lines 21-48, Col. 14, line 56-Col. 15, line 44, and Fig. 3-6	21-24
Y	US 5,354,979 A (Adelson et al) 11 October 1994 (11.10.1994), Col. 2, line 42-Col. 4, line 36	1, 16, 18-19, 38
Y	US 6,014,236 A (Flaherty) 11 January 2000 (11.01.2000), Abstract and Fig. 6	1, 16, 18-19, 38
Y,P	US 6,647,212 B1 (Toriumi et al) 11 November 2003 (11.11.2003), Col. 4, line 49-Col. 5, line 34 and Fig. 2, 4, 6, 9 and 12	4-13, 27-36
Y	US 5,191,460 A (Lapatovich) 02 March 1993 (02.03.1993), Col. 2, line 66-Col. 4, line 41	2-3, 25-26
Y	US 4,887,312 (Dannhaeuser) 12 December 1988 (12.12.1988), Col. 2, line 41-Col. 4, line 30	17



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:	
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

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Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (703)305-3230	Authorized officer <i>Jose Smita - Kelly</i> Jason Chan Telephone No. (703)305-3900

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/22471

Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claim Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claim Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claim Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
Please See Continuation Sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.: 1-38

Remark on Protest

☐
☐

The additional search fees were accompanied by the applicant's protest.

No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

PCT/US03/22471

BOX II. OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING

Group I (Claims 1-38) corresponds to Fig. 5;
Group II (Claims 1,39-54) corresponds to Fig. 6-7;
Group III (Claims 1,55-56) corresponds to Fig. 8;
Group IV (Claims 1,57-62) corresponds to Fig. 16;

Claim 1 is generic.

Group I, claim(s) 1-38, is drawn to a wireless remote unit for use with low noise UV photodetector.

Group II, claims(s) 1 and 39-54, is drawn to a material detector.

Group III, claim(s) 1 and 55-56, is drawn to a traffic detector.

Group IV, claim(s) 1 and 57-62, is drawn to an aircraft collision avoidance system for a plurality of aircraft.

The invention listed as Groups, I, II, III, and IV do not relate to a single general inventive concept under PCT Rule 13.1 because under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

The "special technical features" of Group I are drawn to a wireless remote unit(s) comprise(s) UV LED, a microprocessor connected to the LED and an energy storage device for storing electrical energy. Groups II, III and IV do not share any of these features.

The "special technical features" of Group II are drawn to a material detector(s) which has specifics about power, distance, wavelength, transducer and details of the power source. No groups share any of such features.

The "special technical features" of Group III are the traffic detector(s) comprise(s) at least one light emitting diode having a wavelength shorter than about 310 nm, at least one UV photodetector that detects and generates electrical signal indicative of light detected and a microprocessor coupled to at least one photodetector to determine whether an automobile is present and generate a trigger signal when automobile is determined to be present. No groups share these features for an automobile.

The "special technical features" of Group IV are the aircraft collision avoidance system comprise(s) at least one light emitting diode that emits a first UV light, a first microprocessor having specifics about its modulation of the position of the mirrors, a UV photodetector that detects a second UV light previously encoded and generates an electrical signal in response to second UV light with details of controllable mirrors, and a second microprocessor. No groups share these features for an aircraft avoidance system.

Groups I, II, III and IV do not share each group's "special technical features" either singularly or as a whole. Thus, unity of invention is lacking.